Report 00-201
stern trawler *Seafresh 1*
engine-room fire
north of Chatham Islands
9 March 2000

and

foundering
Hanson Bay, Chatham Islands
17 March 2000

Abstract

On Thursday 9 March 2000 at about 1750 the stern trawler *Seafresh 1*, with 18 crew on board, was steaming about 20 nautical miles north of the Chatham Islands when fire broke out in the switchboard. The engine-room was sealed off and the fire smothered itself. The crew were able to re-enter the engine-room about 6 hours later. There was no electrical or engine power available. While waiting for a tow, the crew discovered water on the factory deck. The crew were eventually able to locate and seal off the ingress and bail out the deck. The chief engineer received moderate injuries while trying to locate the source of the fire. *Seafresh 1* was taken under tow on Friday 10 March 2000 at about 0730 and towed to Hanson Bay where it was anchored at 2000 that night.

Seafresh 1 was still without electrical power and had only minimal on-board services. A skeleton crew remained on board until Monday 13 March 2000 when the weather forecast indicated easterly winds of 50 knots with heavy swells. The master decided to leave the vessel unmanned during the period of bad weather. *Seafresh 1* was observed to ride the storm well at anchor. On Friday 17 March 2000 at about 0830 the harbourmaster saw that *Seafresh 1* had taken a substantial starboard list and alerted the master. Two boats were launched and proceeded out to *Seafresh 1* but the crew were unable to get back on board before the vessel foundered in about 18 m of water.

Safety issues identified included:

- lack of an effective engine-room fire detection system
- lack of a fixed fire smothering system
- method of approach to fire investigation and fire fighting
- inability to replenish compressed air bottles
- standard of securing the vessel before it was left unmanned.

Photograph courtesy of New Zealand Police, Chatham Islands

***Seafresh 1* in Hanson Bay**

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List of Abbreviations

CO_2	carbon dioxide
ETA	estimated time of arrival
kVA	kilo volt ampere(s)
LMC	Lloyds Machinery Certification
m	metre(s)
MSA	Maritime Safety Authority
nm	nautical mile(s)
SOLAS	International Convention for Safety of Life at Sea
UTC	universal time (co-ordinated)

Glossary

aft	rear of the vessel
beam	width of a vessel
bilge	space for the collection of surplus liquid
bridge	structure from where a vessel is navigated and directed
bulkhead	nautical term for wall
by the stern	said of a ship when its draught aft is greater than its draught forward
class	category in classification register
deckhead	nautical term for ceiling
draught	depth in water at which a ship floats
even keel	draught forward equals the draught aft
founder	to fill with water and sink
free surface	effect where liquids are free to flow within a compartment
gross tonnage	a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula
knot	one nautical mile per hour
list	angle of tilt caused by internal distribution of weights
mayday	radiotelephone distress signal requesting immediate assistance
port	left-hand side when facing forward
starboard	right-hand side when facing forward
stability	property of a ship by which it maintains a position of equilibrium, or returns to that position when a force that has displaced it ceases to act up by movements of the steering wheel
trim	difference between the forward and aft draughts of a floating vessel

Data Summary

Vessel Particulars:

Name:	*Seafresh 1*
Type:	stern trawler
Class:	Class X
Classification:	Lloyds Register of Shipping 100A1 Stern Trawler LMC
Length (overall):	44.66 m
Breadth (extreme):	9.5 m
Tonnage (gross):	456.67 t
Built:	1975 in Norway
Propulsion:	a single MaK 8M451AK diesel engine driving, through a reduction gearbox, a controllable pitch propeller
Service speed:	10 knots
Owner/operator:	Seafresh Fisheries Limited
Port of registry:	Napier, New Zealand
Crew:	18

Date, time and location:

Fire:	north of Chatham Islands in position: 43° 21' South 176° 45'West about 1750[1] Thursday 9 March 2000
Foundering:	Hanson Bay, Chatham Islands about 1000 Friday 17 March 2000

Injuries: 1 (moderate)

Investigator-in-charge: Captain John Mockett

[1] All times in this report refer to New Zealand Daylight Time (UTC + 13) and are expressed in the 24-hour mode. Note that the Chatham Islands keep UTC + 13.75.

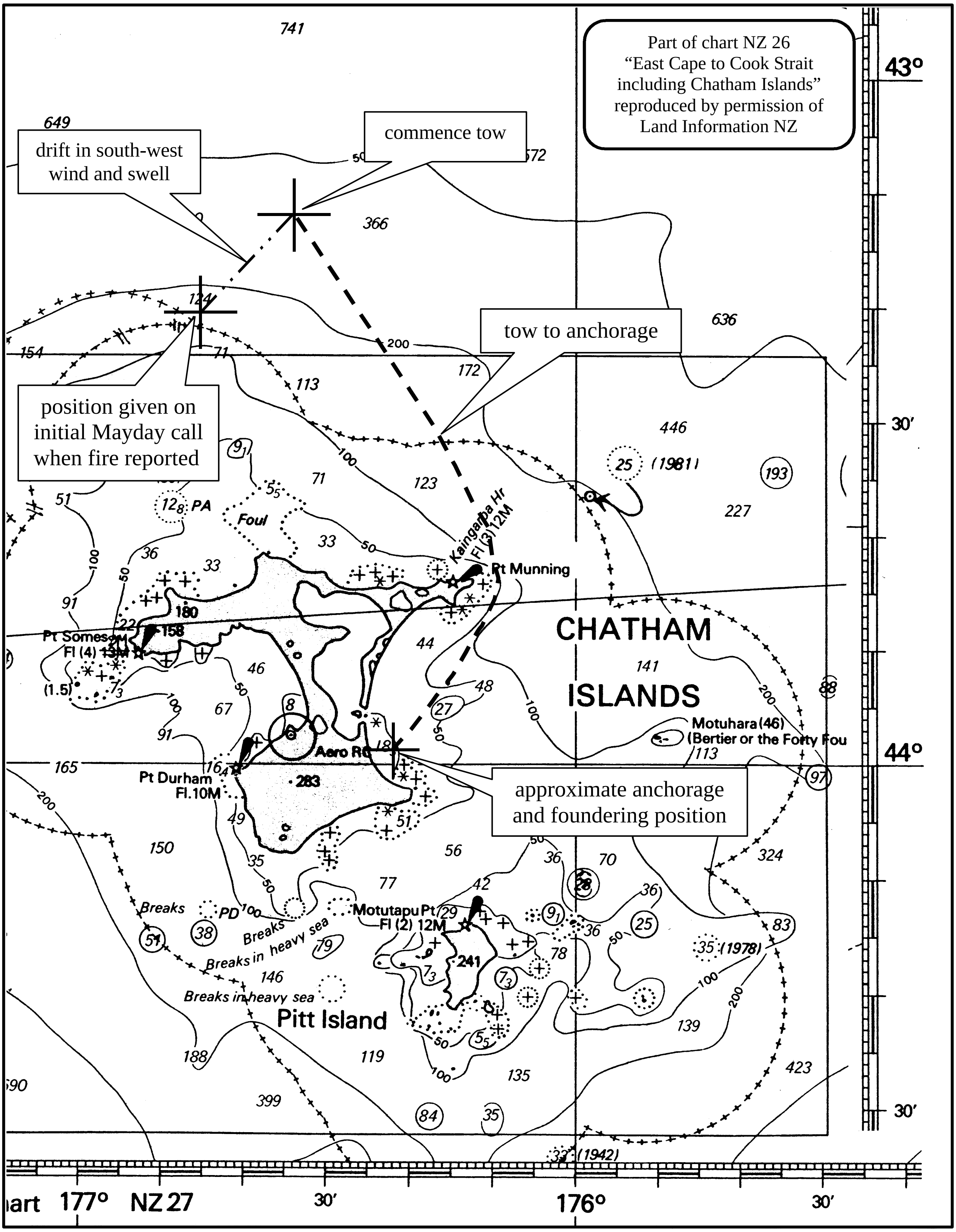

Figure 1
Part of chart NZ 26 showing key positions

1. Factual Information

1.1 History of the voyage

1.1.1 At about 1730 on Thursday 9 March 2000, *Seafresh 1* was steaming east about 20 nautical miles (nm) north of the Chatham Islands (see Figure 1). The master was watchkeeping on the bridge and was joined by the mate, the chief engineer and the second engineer. The engineers were due to change watch at 1800 and intended to discuss the day's work. The mate was not due to take over the bridge watch until midnight. One of the 2 bosuns was also on the bridge.

1.1.2 At about 1750, the master was informed by telephone that the engine-room alarm was sounding in the messroom area and that the galley had lost all electrical power. The chief engineer went to the engine-room to investigate the cause of the alarm. As he was leaving the bridge, the master called out to him that power had also failed in the wheelhouse.

1.1.3 As the chief engineer approached the engine-room access door in the factory deck he noticed smoke coming from the door and accumulating in the aft section of the factory deck. He telephoned the bridge to advise the master of the fire. He then entered the engine-room and made a brief inspection but was unable to locate the seat of the fire and could not stay inside because of the smoke. He stated later that he noticed that it was "raining" in the engine-room.

1.1.4 Meanwhile, the master sounded the general fire alarm. The second engineer and the bosun took the 2 breathing apparatus sets to the factory deck where they met the chief engineer coming out of the engine-room. The second bosun joined them in the factory deck.

1.1.5 The second engineer donned one breathing apparatus and entered the engine-room to try to find the seat of the fire. The compressed air bottle that he was using was part filled only, having been used during a drill the previous week. The facemask that he was wearing developed a leak due to a broken strap and the increasing smoke forced him to leave the engine-room before he was able to locate the fire.

1.1.6 The mate accounted for all of the remaining crew at their muster stations and then went to the factory deck. He returned to the bridge and told the master that there appeared to be a serious fire, but the location had not yet been found. He then took the spare compressed air bottle back to the factory deck.

1.1.7 The spare bottle was fitted to the breathing apparatus worn by the second engineer and the air leak at the facemask rectified. The second engineer then went back into the engine-room with instructions from the chief engineer to firstly stop the main engine and then to stop the port diesel generator, restart it and reset the switchboard. Emergency lighting was on, but with the increasing amount of smoke, visibility was limited. The second engineer stated later that he also noted that it was "raining" in the engine-room.

1.1.8 The second engineer attempted to shut down the main engine by winding back its governor but succeeded only in reducing it to idle. He stopped and restarted the port diesel generator but was unable to reset the switchboard.

1.1.9 The chief engineer activated the remote stops for main engine and diesel generator fuel. He then re-entered the engine-room wearing breathing apparatus. The smoke had increased and visibility was almost zero. When he passed the switchboard he saw a glow within one of the cabinets and felt intense heat coming from it. He called to the second engineer to leave the engine-room. Both engineers exited and shut the access door. They had been unable to remain in the engine-room long enough to use the CO_2 extinguisher that was at the top of the access ladder.

1.1.10 The chief engineer reported the situation to the master, telling him that no fire fighting could be attempted at that time. The master decided to seal the engine-room in the hope that the fire would smother itself.

1.1.11 The master had been in contact with Search and Rescue in the Chatham Islands and advised it of the latest developments. Two boats, *Strauss* and *Stryker*, had been dispatched to assist.

1.1.12 The weather was south-westerly wind at 25 to 30 knots with a 3 to 4 m swell. Without electrical or motive power *Seafresh 1* was "dead ship" and rolling heavily, reportedly up to 40 degrees each side.

1.1.13 The crew saw water coming into the factory deck and attempted to locate its source while using a diesel oil emergency fire pump to pump out the water. The pump frequently blocked with fish scale and offal and was unable to keep up with the ingress.

1.1.14 The engineers suspected that the offal overboard chute was the point of ingress and tried to close the non-return flap. The spindle actuator turned freely but was not closing the flap because the threaded block through which the spindle passed had broken free of its mounting and was turning with the spindle (see Figure 2).

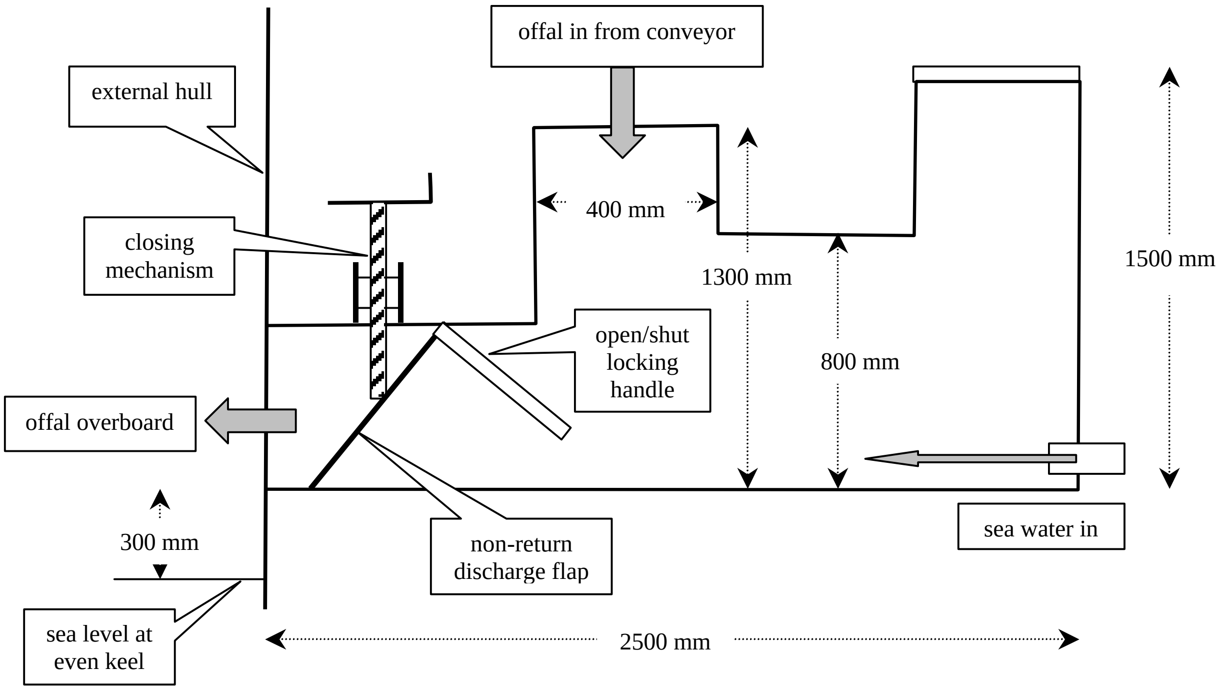

Figure 2
Side elevation of offal overboard discharge with approximate dimensions (not to scale)

1.1.15 The engineers saw some ingress of water through the spindle gland and packed around the area to reduce it. The non-return flap had an operating handle that allowed it to be locked in either the open or shut position. However, the handle had sheared off and the flap could be heard banging against its stop when the vessel rolled.

1.1.16 The mate had closed the overboard discharges for the factory deck bilge pumps and he told the chief engineer that the handle on the port aft one had broken. They found that a considerable amount of water was upwelling through the bilge after each roll to port.

1.1.17 The crew had been bailing the water out with buckets and had been able to keep up with the rate of ingress but each time they stopped bailing the water level increased. The chief engineer reported the situation to the master. They discussed opening the overboard discharge of the port aft bilge. They decided that although there was a risk of increasing the ingress, that risk had to be taken because with the ingress as it was, the crew would be physically unable to continue bailing without stopping.

1.1.18 The master had informed Search and Rescue of the water ingress and contingency plans for abandoning the *Seafresh 1* were discussed. The vessels *Strauss* and *Stryker* had estimated times of arrival (ETAs) of 2230 and 2330 respectively. The *Amaltal Endeavour* had offered assistance should it be required and had ceased fishing at 0030 on Friday 10 March and was proceeding to the scene with an ETA of 0730.

1.1.19 The water on the factory deck had the effect of providing some boundary cooling for the engine-room. The crew had been monitoring the temperature of other surfaces such as the access door, and the temperatures had noticeably cooled. Because of concerns about possible ingress of water to the engine-room, the master decided to open the engine-room for inspection at about 0030 on Friday 10 March. Before entering the engine-room the engineers waited for the smoke to dissipate enough for them to see.

1.1.20 Meanwhile they used an oxy-acetylene torch to remove the nuts on the inspection cover of the port aft factory deck bilge and discovered that the closing flap had fractured from its spindle. They packed the inspection box and bilge uptake with plastic and rags and clamped the cover back in position. By about 0100 it appeared that the ingress of water had reduced and as the crew continued to bail the level of water on the factory deck lowered (see Figure 3).

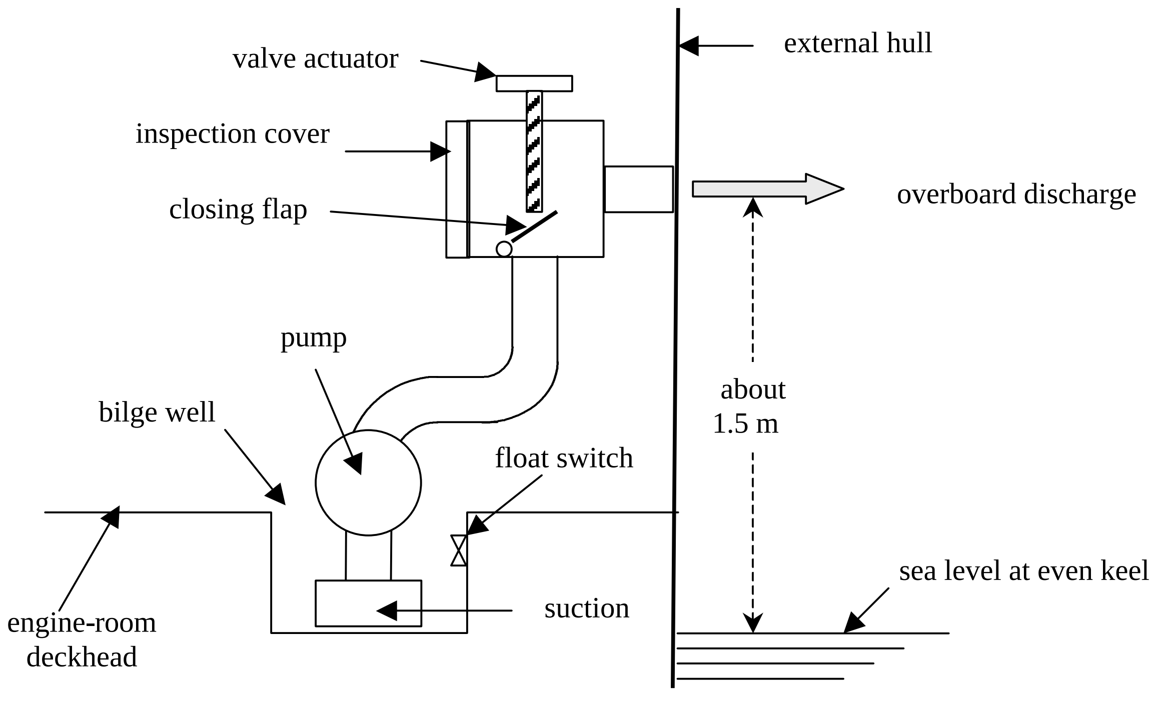

Figure 3
Diagram of factory deck bilge discharge
(not to scale)

1.1.21 When the engineers re-entered the engine-room they found that the seat of the fire had been in the switchboard but was extinguished. A secondary fire in a stow of rags behind the switchboard had re-ignited and had to be extinguished.

1.1.22 The main engine-driven bilge pump had previously been known to back-flood through its overboard discharge and had been cause for concern while the engine-room was sealed. The engineers found that there was some water under the bottom plates, but it did not appear to be increasing. They checked that all the sea suctions and discharges were closed. They were unable to access the sea suctions for the diesel generators because the valves were under water.

1.1.23 They found that the bilge pump priming line had fractured where it connected to the main engine sea water cooling line. The line consisted of a threaded stud and socket welded to the cooling line. A gate valve led to a flexible hose joined to the bilge pump. The sea water cooling pump was no longer running so there was no water leaking from the fracture. The engineers closed the sea suction of the pump anyway.

1.1.24 By about 0200, the master informed Search and Rescue that the crew had reduced the level of water in the factory deck and the ingress seemed to be contained. He also confirmed that the fire in the engine-room was extinguished.

1.1.25 The weather conditions were worsening with winds up to 45 knots and swells up to 5 m. The *Strauss* and *Stryker* were having difficulty in the conditions and requested permission from Search and Rescue to return to the Chatham Islands. The 2 boats left the *Seafresh 1* at about 0230. Although the masters were reluctant to leave the scene, they were concerned for the safety of their own vessels and crews. They knew that the situation on *Seafresh 1* had stabilised and other assistance was on the way.

1.1.26 The crew on *Seafresh 1* continued to bail out the factory deck until it was virtually dry and continued to monitor the engine-room for any hot spots. Meanwhile, the weather remained south-west winds of 45 knots and a south-west swell of 5 m. *Seafresh 1* was drifting to the north-east.

1.1.27 *Amaltal Endeavour* arrived at the *Seafresh 1* at about 0730 and established the tow by about 0830. The passage to Hanson Bay commenced immediately and the tow arrived at the south end of Hanson Bay at about 2000 on Friday 10 March. *Seafresh 1* anchored about 2 miles off Owenga in about 18 m of water (see Figure 4).

1.1.28 Once anchored, 12 of the crew were taken ashore leaving the master, mate, chief engineer, one bosun and 2 deckhands on board overnight.

1.1.29 Over the next 2 days a skeleton crew remained on board while portable generators supplied essential services.

1.1.30 On the afternoon of Monday 13 March, the master received a forecast that predicted winds up to 40 knots from the north-west, veering east later. He was reluctant to leave crew on the vessel overnight in case it should drag or break its anchor, leaving them adrift on a dead ship. The master conferred with the harbourmaster and a Maritime Safety Authority (MSA) oil spill co-ordinator who was on the island conducting an exercise. He decided to leave the *Seafresh 1* unmanned overnight on Monday 13 March. The harbourmaster agreed to watch the vessel from the vantage point of his residence overlooking Hanson Bay.

1.1.31 The wind veered to the east during the night of Tuesday 14 March and increased to about 40 knots. The swell from the east rose to 4 to 5 m. The bad weather continued through until Thursday 16 March.

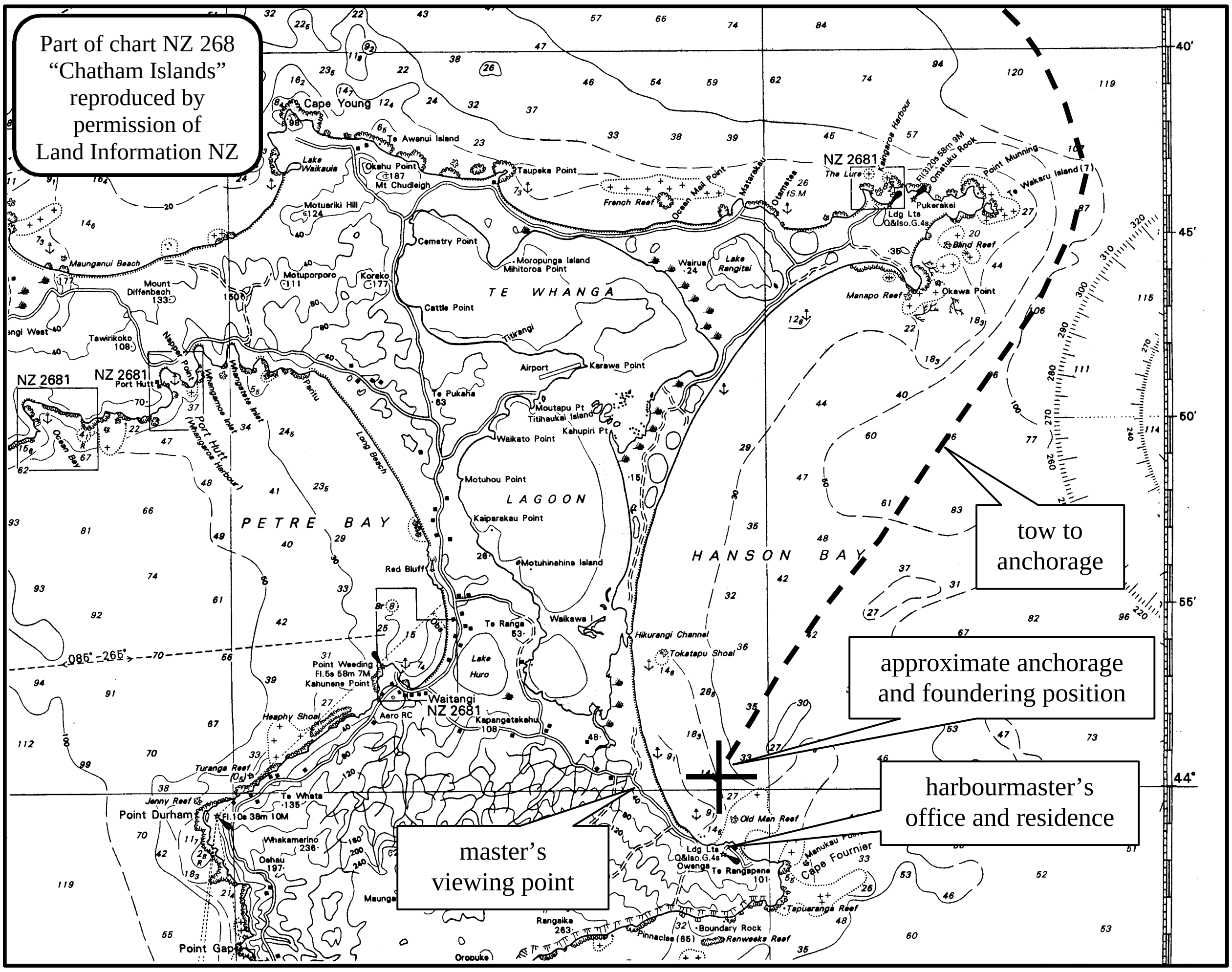

Figure 4
Part of chart NZ 268 showing key positions

1.1.32 When the master observed *Seafresh 1* on the evening of Thursday 16 March, the wind was still from the east but had reduced to about 20 knots. The easterly swell was still at 4 to 5 m and the vessel was riding to the wind and swell. The vessel had maintained its anchor position throughout the bad weather.

1.1.33 When the harbourmaster saw *Seafresh 1* at dawn on Friday 17 March it was riding to the wind and sea and had not changed position. The wind veered to the south-south-east just after dawn. When he next observed the vessel at about 0830, it had developed a starboard list of about 20 degrees and was rolling heavily. He immediately telephoned the master in Waitangi.

1.1.34 The master and crew came immediately to Owenga, where 2 boats were launched and together with several locals they went out to *Seafresh 1*. By the time the boats arrived at *Seafresh 1*, the list had increased and the stern was underwater. It was impossible to get on board *Seafresh 1* and over the next 30 to 40 minutes the vessel foundered, sinking in about 18 m of water.

1.2 Vessel information

1.2.1 *Seafresh 1* was built in Norway in 1975 and after several changes of ownership was purchased by Seafresh Fisheries Limited in July 1998. The vessel was a factory freezer stern trawler, with the catch being processed on board and stowed in the refrigerated holds (see Figure 5).

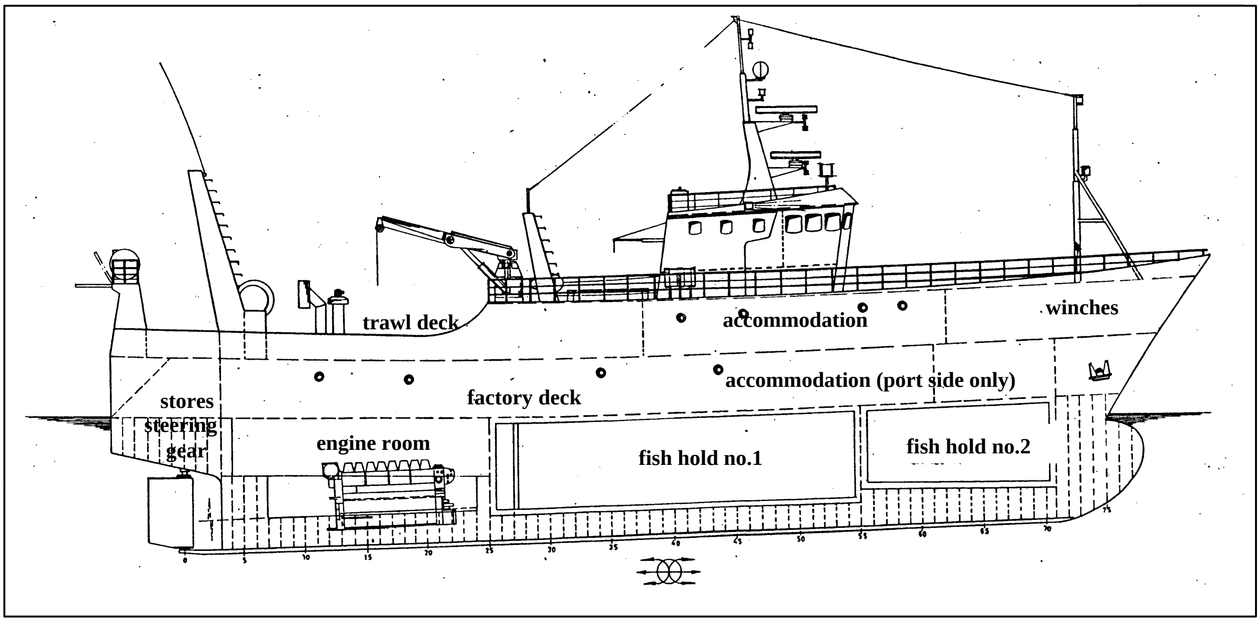

Figure 5
General arrangement of *Seafresh 1*

1.2.2 *Seafresh 1* was registered in Napier and surveyed by Lloyds Register of Shipping classification society under SOLAS rules. The vessel had a Lloyds class of 100A1 Stern Trawler LMC. The MSA classed the vessel as New Zealand Fishing Ship Class X. *Seafresh 1* had a Safe Ship Management certificate valid until 1 July 2003.

1.2.3 In the factory deck there were 3 bilge wells each with a pump and overboard discharge. Because of the amount of water accumulated in the deck during fishing operations, the pumps were rarely turned off and were activated by float switches in the bilge wells. The bottom of the bilge wells were at or about the waterline and the overboard discharges about 1.5 m above that.

1.3 Electrical system

1.3.1 Electrical power supply was provided by two 250 kVA, 380 volt, 3-phase diesel generators that could be synchronised and run in parallel, or run separately. The generators had originally both connected onto the common bus bars of the main switchboard through individual protective circuit breakers.

1.3.2 Modifications had been made to the main switchboard to allow number 2 generator to be directly connected to the fish factory services, the Hiab deck crane and the number 2 refrigeration compressor, while being isolated from the common bus bars. The modifications were made because those occasional large loads had the potential to overload the main switchboard if only one generator was running. Number 1 generator supplied electrical power to the rest of the ship via the main switchboard bus bars.

1.3.3 At the time of the fire, number 2 generator was not connected to the main switchboard but was providing power directly to the number 2 refrigeration compressor. The fish factory and Hiab deck crane were not in use. Number 1 generator was connected to the main switchboard and provided power to all other services on board.

Main switchboard construction

1.3.4 The switchboard was constructed with open spaces between all cubicles. The top was covered with a lid that was wider than the main switchboard footprint to allow hot air to vent from within the board.

1.3.5 The board was divided into five sections that each had a main functional purpose. The sections, from aft to forward, were:

1. Shore power and 3-phase distribution.
2. Number 1 diesel generator.
3. Synchronising and controls.
4. Number 2 diesel generator and distribution.
5. Three-phase distribution.

1.3.6 The front panels had cut-out holes through which the operating handles of the vertically mounted moulded-case circuit breakers protruded. The rear doors allowed direct access to the bus bars. Cable entry and exit were from below the floor plates. The cables then ran up the bulkhead behind the switchboard and onto overhead cable ladders out to the various loads.

1.4 Other information

1.4.1 Information was obtained or confirmed from photographs and a video recording taken when *Seafresh 1* arrived at Hanson Bay after the fire and from video recordings taken by divers after the foundering.

1.4.2 Heat and fire damage was minimal and contained within the main switchboard and its immediate surroundings. Several moulded-case circuit breakers had burnt out leaving white ash deposits and exposed metal conducting parts. These metal parts are normally fully enclosed within the moulded plastic case of the circuit breaker with only the connection terminals being exposed. The most severe damage was restricted to several moulded-case circuit breakers in the top of section 4, the number 2 generator panel and distribution.

1.4.3 Some cables above the switchboard showed signs of fire damage and a small fire had started in a stow of rags behind the main switchboard. Those crew spoken to after the fire noted the smoke as being black with a very strong plastic smell and that it had stung their eyes.

1.4.4 While waiting for *Amaltal Endeavour* to arrive, *Seafresh 1* was rolling heavily and continued to take water into the factory deck, albeit at a much reduced rate. The crew had to bail out the factory deck about 3 hours after first getting it dry. Once under tow, and not rolling to the same degree, the ingress almost completely stopped.

1.4.5 A video recording taken when *Seafresh 1* was at anchor on Saturday 11 March 2000, showed the vessel with a reasonably large stern trim and the offal overboard discharge could not be positively identified. The stern trim may have been sufficient to have put the discharge under water.

1.4.6 The recording showed the fire and heat damage in the area of the switchboard in the engine-room. The recording also showed the factory deck where the temporary repair to the port bilge overboard discharge could be seen still in place.

1.4.7 On the soundtrack of the recording a loud rhythmic banging could be heard. The banging was identified as the non-return flap in the offal overboard discharge swinging freely in time with the rolling of the vessel and banging back against its inboard stop. The recording showed that the locking handle was not moving, indicating that it was no longer attached to the flap (see Figures 6 and 7).

1.4.8 An underwater video recording taken by divers after *Seafresh 1* foundered, showed the engine-room, factory deck and part of the accommodation. At the offal overboard discharge, the recording showed the closing device. The packing around the gland was still loosely in place and the threaded block though which the spindle travelled was dislodged from its supports.

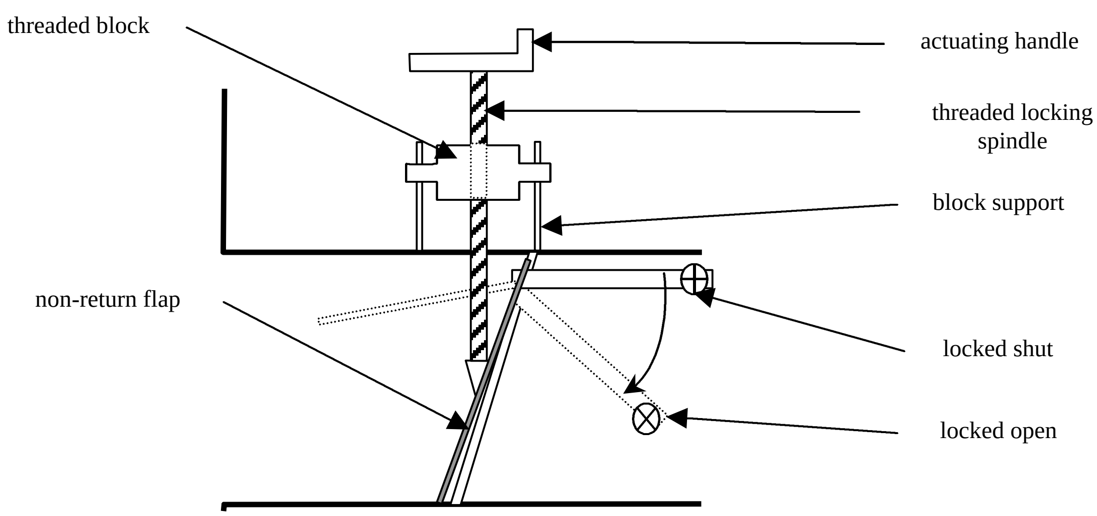

Figure 6
Offal overboard discharge closing devices shown as designed
(not to scale)

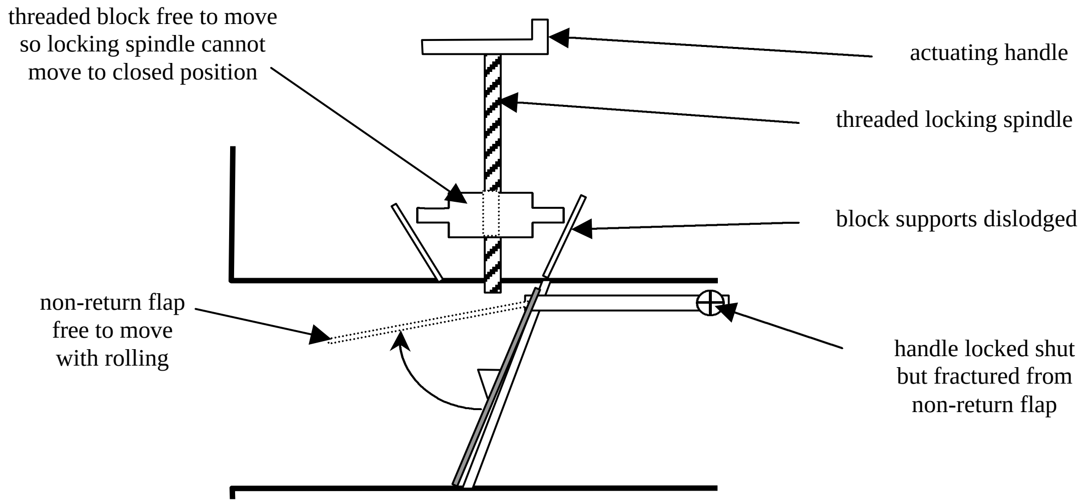

Figure 7
Offal overboard discharge closing devices shown as observed
(not to scale)

1.4.9 The video recording showed that the following doors and hatches were open:

- the engine-room access (tied back)
- emergency escape hatch in the factory deck
- the steering gear and stores.

1.4.10 Divers retrieved the fractured bilge pump priming pipe and Figure 8 shows the amount of internal corrosion at the fracture in the threaded socket.

Figure 8
Internal corrosion in fractured pipe

1.5 Personnel information

1.5.1 *Seafresh 1* had a crew of 18, comprising master, mate, chief engineer, second engineer, 2 bosuns, 4 deckhands, factory manager, assistant factory manager, 5 factory hands and one cook.

1.5.2 The master had been at sea in the fishing industry since 1979 with the exception of a 5-year break. He held certificates as Skipper Deep Sea and First Class Diesel Trawler Engineer. He had worked previously for Seafresh Fisheries Limited from 1996 to 1998. He rejoined the company in 1999 and was on his second voyage on *Seafresh 1*.

1.5.3 The mate, who also acted as fishing master, had been at sea in the fishing industry for over 20 years. During the previous 20 years he had predominantly sailed as master with occasional trips as mate or fishing master. He held a New Zealand Skipper Deep Sea certificate and an Australian Skipper 1A certificate. He had worked for Seafresh Fisheries for about 5 years and had previously made one trip on *Seafresh 1* in 1999.

1.5.4 The chief engineer had been at sea in the fishing industry for 15 years. He held a First Class Diesel Trawler Engineer certificate. He had worked for Seafresh Fisheries Limited for about 18 months and had served all that time on *Seafresh 1*.

1.5.5 The second engineer served an apprenticeship with a Nelson engineering company and then worked with the same company for 8 years. For the previous few years he had been self-employed doing contract work for various marine engineering companies in the Nelson area involved in ship repair and maintenance. He held no marine qualification and the trip on *Seafresh 1* was his first at sea.

2. Analysis

2.1 The fire

2.1.1 When the chief engineer left the engine-room towards the end of his duty time, the main engine was running together with its associated pumps. Both diesel generators were running, with number 1 supplying power to general services and number 2 supplying power only to number 2 refrigeration compressor.

2.1.2 The electrical load on the main switchboard was well within the capacity of number 1 generator and would not have been affected by the occasional starting of the refrigeration compressor because that was being fed directly from number 2 generator. It was unlikely that the switchboard was subjected to any overloading.

2.1.3 The main engine was cooled by a sea water system and the pump circulated water at a pressure of 2.2 bar. The bilge pump priming line that was fed off the top of the main sea water cooling line was corroded internally and fractured, probably shortly after the chief engineer left the engine-room. The remaining pipe stub had an internal diameter of about 15 mm. The resulting jet of sea water would have easily risen to the engine-room deckhead where it was probably deflected in most directions (see Figure 9).

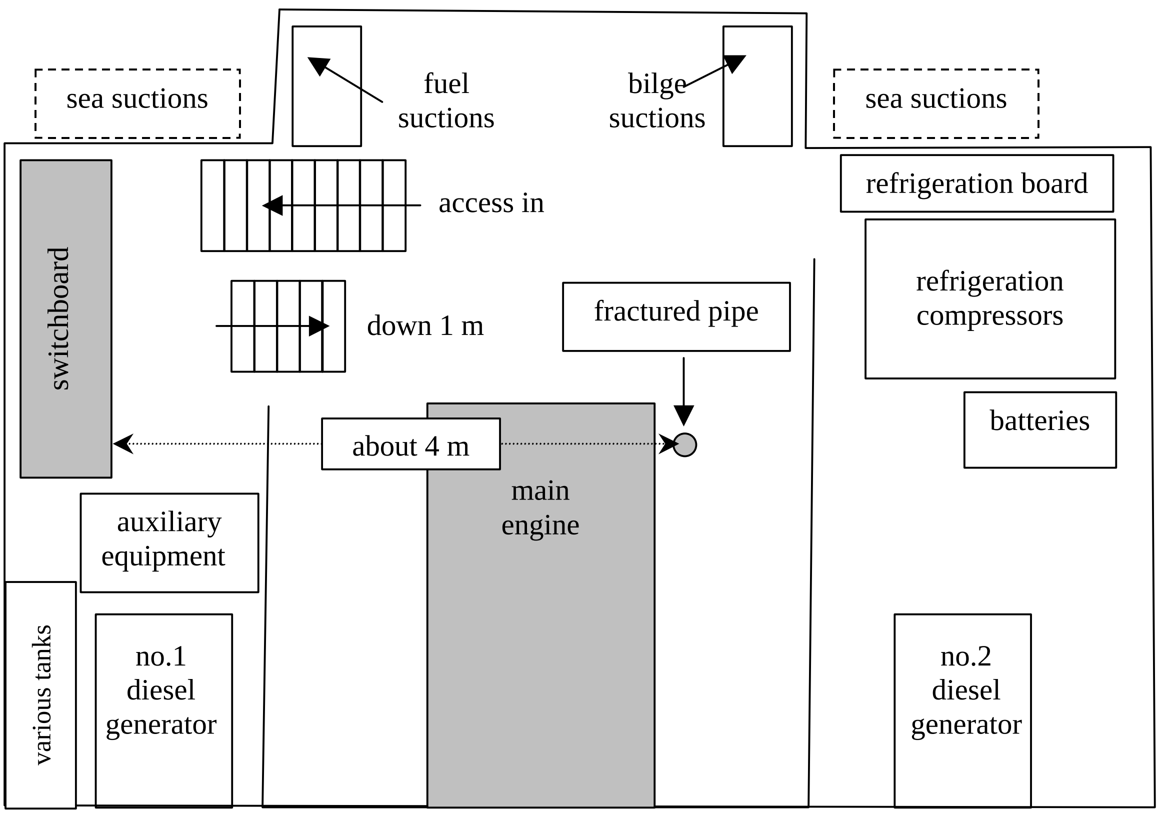

Figure 9
Simplified diagram of forward end of engine-room layout
(not to scale)

2.1.4 The fractured pipe was on the starboard forward side of the engine and although the switchboard was positioned on the port side of the engine about 4 m away horizontally, the force of the jet of water, even after being deflected at the deckhead, would have been sufficient for a significant amount of sea water to have sprayed onto the switchboard.

2.1.5 Further, sea water may have run along cable trays, pipes and the vessel's structure and dropped onto the switchboard.

2.1.6 The switchboard was not intended to be watertight and sea water probably penetrated the circuit breakers. Salt water is a conductor and probably bridged out the live terminals within the circuit breakers. The temperature rise from the resulting excessive short circuit current would have been sufficient to cause the plastic circuit breaker insulation material and cable insulation to smoulder. The number 1 generator probably continued to feed the hot spot until it shut down or was automatically isolated by its supply circuit breaker, but by this time the combustible materials within the switchboard had sufficient heat to have caused the fire.

2.1.7 Although number 2 generator was still running, it was feeding the refrigeration compressor only, so electrical power was lost to all other services. The sea water cooling pump would have stopped and so too would the jet of water from the fractured pipe. There would still have been an accumulation of water on the deckhead and fittings. That water dripping from the deckhead would explain the engineers' description of "raining" when they first entered the engine-room.

2.1.8 The first indication of an emergency situation was the power failure and associated engine-room alarm sounding in the galley and messroom area. There was no way of knowing that this may have been caused by a fire until the chief engineer went to the engine-room and observed smoke.

2.1.9 An effective fire detection system for the engine-room would have alerted the crew to the fire and allowed them to initiate the appropriate emergency action earlier. Once the existence of fire was known an effective fire fighting plan probably could have saved the switchboard in this case.

2.1.10 The crew's initial approach to fighting the fire was not co-ordinated and did not follow the basic principles of effective fire fighting. Once initial attempts to fight the fire failed, the decision to seal the engine-room and isolate the power source was appropriate and effectively extinguished the fire. Further crew training and a review of emergency response plans are required.

2.1.11 The vessel was fitted with a fixed remotely operated fire smothering system but it had been decommissioned because the inert gas used was Halon, which was not accepted as an extinguishing medium. Had the system been modified to use CO_2 it would have been effective in smothering the fire quickly.

2.2 Water ingress and the foundering

2.2.1 The fire disabled *Seafresh 1*, leaving it adrift and rolling heavily in bad weather, reportedly up to about 40 degrees each side. Such a degree of rolling, particularly with the vessel trimmed by the stern, would cause the overboard discharges for the factory deck bilge pumps and the offal chute to be deeply immersed.

2.2.2 The 3 bilge pump overboard discharges had been closed. The pump discharges on the starboard side of the factory deck remained watertight but the closing valve on the port side pump discharge was fractured, allowing water to back-flow through the discharge onto the factory deck.

2.2.3 Water leaks from the offal overboard discharge were found and reduced before the major leak from the bilge pump was found. Once the ingress from the bilge pump discharge had been controlled, the crew were able to bail out the factory deck. A number of other smaller leaks were also noted. *Seafresh 1* continued to roll heavily while waiting for the towing vessel and water continued to accumulate in the factory deck and had to be bailed after about 3 hours.

2.2.4 During the tow to Hanson Bay *Seafresh 1* would have been rolling less and also pitching slightly because of the forward motion, and the ingress of water virtually stopped. Once in the shelter of the Hanson Bay anchorage in relatively calm conditions, no further ingress occurred.

2.2.5 The master's decision to leave *Seafresh 1* unmanned while bad weather passed the area was based on the safety of the crew who might have remained on board. Considering the severity of the forecast and the condition of *Seafresh 1*, without electrical or motive power, his decision was appropriate.

2.2.6 Before leaving the vessel it would have been prudent to have thoroughly prepared it for the expected weather. There were areas of known or suspected water leaks that should have been checked and attempts made to secure them. The securing devices of the non-return flap in the offal overboard discharge were known to be damaged and some method of securing the flap could have been investigated. The doors and vents throughout the vessel should have been secured.

2.2.7 *Seafresh 1* was observed from ashore during the period of bad weather. When the winds and swell were from the east, the vessel lay to them and rode to the anchor with a pitching and rolling motion. The conditions were such that spray would have been taken over the decks. The motion would have been similar to, but possibly more severe than that when *Seafresh 1* was under tow. No water leaks were noted during the tow and the vessel probably remained essentially dry during the easterly weather.

2.2.8 When the wind veered to the south-south-east, the easterly swell remained at about 5 m. *Seafresh 1* was observed to lay to the wind rather than the swell, so laying almost beam on to the swell. Under such conditions the predominant motion of the vessel would become severe rolling.

2.2.9 The conditions on board *Seafresh 1* were then similar to those while waiting for the tow. It was during that time that water ingress to the factory deck was noted. Despite packing the port bilge and offal chute discharges, water ingress was such that bailing was required after about 3 hours.

2.2.10 After dawn on Friday 17 March 2000 the vessel would have been rolling heavily and, in the same way as previously, would have suffered an accumulation of water in the factory deck. The vessel was trimmed by the stern and that trim would increase with the added weight of water.

2.2.11 As the trim increased so too would the aft draft and various overboard discharges would become more deeply immersed during the rolling, and the rate of water ingress would increase proportionally. The reserve buoyancy and stability of *Seafresh 1* would have progressively deteriorated.

2.2.12 Each time *Seafresh 1* rolled to starboard, the non-return flap in the offal overboard discharge would have swung open, allowing water to be scooped into the casing. The flap would close as the vessel rolled to port. Initially the water might have been contained within the casing but as the vessel settled and greater amounts of water entered it would spill over into the factory deck.

2.2.13 As the volume of water on the factory deck increased it would have eventually entered the engine-room through the open access and escape hatch and entered the steering gear through the open stores door at the aft end of the factory deck.

2.2.14 As the area covered by the water increased, the free surface effect of the water would have progressively reduced the stability of the vessel. When contained in the aft end of the factory deck the flooding would have been symmetrical, but once the water flooded forward of the workshop the flooding would have been asymmetrical and the vessel would start to list to starboard (see Figure 10).

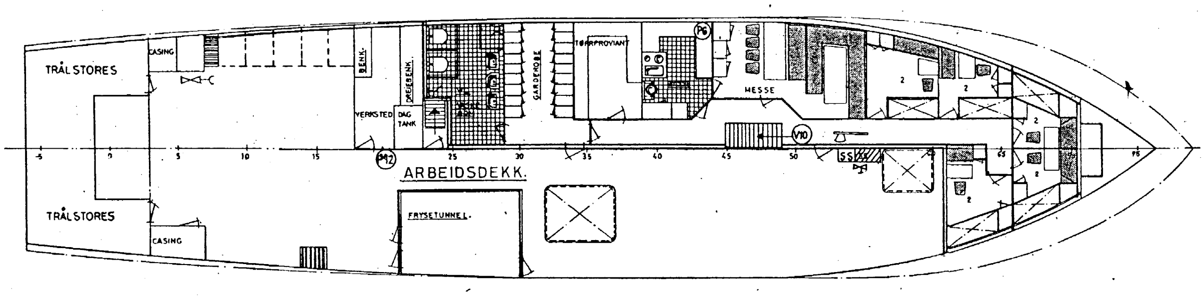

Figure 10
Plan of the factory deck on *Seafresh 1*

2.2.15 The starboard list would significantly increase the draft on that side, causing the offal overboard chute discharge to become deeply immersed with its non-return flap open most of the time.

2.2.16 Once this condition was reached, the ingress of water through the offal discharge would be almost continuous and of substantial volume. The stern trim and starboard list would significantly increase, further advancing the flooding.

2.2.17 With several open doors leading off the factory deck the flooding would continue through to other spaces until the vessel eventually foundered.

3. Findings

3.1 *Seafresh 1* was operating under a valid Safe Ship Management certificate and crewed to a level above that required by legislation.

3.2 The electrical loads on the switchboard in the engine-room were likely to have been within design parameters.

3.3 The fire in the switchboard was probably caused by sea water from a fractured bilge pump priming line spraying onto the circuit breakers, causing them to short circuit.

3.4 The priming line fracture probably resulted from internal corrosion.

3.5 Had an effective fire detection system been installed in the engine-room, the crew would probably have been alerted to the fire in time to save part of the switchboard.

3.6 The crew's approach to fighting the fire once it had been detected would have benefited from further training and better assessment of emergency response plans.

3.7 Had a fixed fire smothering system been available and properly operated, the fire would have been extinguished quickly and possibly in time to save part of the switchboard.

3.8 Once *Seafresh 1* became disabled by the fire and began rolling heavily to rough seas, water back-flooded into the factory deck through a faulty non-return flap in the bilge pumping and offal chute arrangements.

3.9 Temporary measures taken by the crew to control the amount of water on the factory deck were appropriate for the tow into sheltered waters but it would have been prudent to have made more permanent repairs before leaving the vessel unmanned in rough seas.

3.10 While riding at anchor unmanned, *Seafresh 1* probably turned beam on to the swells and began to roll heavily, causing sea water to back-flow through the faulty non-return flaps.

3.11 Water accumulating on the factory deck caused the vessel to progressively settle by the stern and list to starboard. Down-flooding probably occurred into the engine-room and steering flat through watertight openings that had been left open, until the vessel lost all reserve buoyancy and foundered.

3.12 The master of *Seafresh 1* made an appropriate decision to leave the vessel unmanned under the circumstances, but the vessel was not adequately secured before the crew departed.

4. Safety Recommendations

4.1 On 20 September 2000 it was recommended to the Chairman of Seafresh New Zealand Limited that he:

4.1.1 Fit a suitable fire detection system in the engine-rooms of all company vessels. (061/00)

4.1.2 Evaluate all company vessels and where practicable fit fixed fire smothering systems in the engine-rooms. (062/00)

4.1.3 Provide an air compressor for refilling breathing apparatus bottles to each of the company vessels fitted with self-contained breathing apparatus. (063/00)

4.1.4 Ensure that training sufficiently equips the crew to properly follow the emergency response plans contained in the safe ship management manuals. (064/00)

5.2 On 19 October 2000 the Chairman of Seafresh New Zealand Limited replied:

5.2.1 In response to your recommendations I can advise that:

- We do already have in existence suitable fire detection systems in the engine-rooms of all company vessels (061/00)
- We are also careful to ensure that our safety training equips the crew to properly follow the emergency response plans contained in the safe ship management manuals (064/00)

We are currently considering your other recommendations [062/00 and 063/00] and will advise you in due course after investigating the viability of these other recommendations.

Approved for publication 27 September 2000

Hon. W P Jeffries
Chief Commissioner